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The application of coherent anti-Stokes Raman spectroscopy for remote molecular detection[1] JABIR CHATHANATHIL, GENGYUAN LIU, SVETLANA MALINOVSKAYA, Stevens Institute of Technology — A method is proposed theoretically to detect the presence of chemicals and hazardous contaminants in the atmosphere remotely by using the CARS (Coherent Anti-Stokes Raman Spectroscopy) technique. The anti-Stoke pulse scattered by air molecules distant from the source can be detected to determine their presence. The depletion of pulse amplitudes as they propagate through 1 km air is calculated. A semiclassical theory of nonlinear scattering without decoherence is used to find the Maxwell-Liouville-von Neumann equations for the pump, Stoke, probe and anti-Stoke components of the pulses. Two cases of incoming pulses, transform-limited and chirped with roof method, are examined for different pulse durations. For 100fs pulse duration, the coherence and the anti-Stoke enhancement are very high as predicted theoretically. A model in which the target molecule density has Gaussian distribution is proposed for this method. The change in energy of molecules as well as pulses at each scattering event is examined to verify the energy is conserved throughout the process. The conservation of total population of energy levels is tested as a second way of verification. The pulses are individually studied after each scattering event and a method is developed to extract the phase from each pulses.

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